

## CLAIMS

We claim:

1. A composition comprising a plurality of nucleic acids of the same length, each nucleic acid comprising:

- a) an invariant sequence; and
- b) a variable sequence;

wherein said plurality comprises every possible variable sequence.

2. A composition according to claim 1, wherein said variable sequence comprises a nucleotide decoding position, and each unique nucleotide at said decoding position comprises a different label.

3. A composition according to claim 2, wherein said variable sequence comprises at least one nucleotide between said invariant sequence and said nucleotide decoding position.

4. A composition according to claim 1, wherein said variable sequence is immediately adjacent to said invariant sequence.

5. A composition comprising a set of nucleic acids of the same length, each nucleic acid comprising:

- a) an invariant sequence; and
- b) a variable sequence comprising a single label and a plurality of nucleotide decoding positions;

wherein at any single nucleotide decoding position within the set, each label comprises a different nucleotide.

6. A composition according to claim 5, wherein at least one of said plurality comprises at least one universal base in said variable sequence.

7. A composition according to claim 5, wherein at least one of said plurality comprises a plurality of universal bases in said variable sequence.
8. A composition according to claim 5, wherein each of said plurality comprises at least one universal base in said variable sequence.
9. A composition according to claim 5, wherein each of said plurality comprises a plurality of universal bases in said variable sequence.
10. A method of decoding an array composition comprising
  - a) providing an array composition comprising:
    - i) a substrate with a surface comprising discrete sites; and
    - ii) a population of microspheres comprising at least a first and a second subpopulation distributed among said discrete sites, wherein each subpopulation comprises an identifier nucleic acid sequence comprising:
      - 1) a primer sequence; and
      - 2) a decoding sequence adjacent to said primer sequence;wherein said microspheres are distributed on said surface; and
  - b) adding to said array composition a first set of combinatorial decoding probes each comprising:
    - i) a priming sequence complementary to said primer sequence;
    - ii) at least one decoding nucleotide that will basepair with at least one nucleotide of at least one of said decoding sequences; and
    - iii) a label unique to said decoding nucleotide; and
  - c) detecting the presence of said label.

11. A method according to claim 10 further comprising removing said decoding probes and repeating steps b) and c), wherein said decoding nucleotide will basepair with a different nucleotide of said decoding sequence.
12. A method according to claim 11 further comprising compiling the sequence of said decoding sequence.
13. A method according to claim 10 wherein each subpopulation further comprises a candidate bioactive agent.
14. A method according to claim 13 wherein said identifier nucleic acid comprises said candidate bioactive agent.
15. A method according to claim 10 wherein at least one of said decoding probes comprises at least one universal base.
16. A method according to claim 10 wherein a plurality of said decoding probes comprises at least one universal base.
17. A method according to claim 10 wherein a plurality of said decoding probes each comprise a plurality of universal bases.
18. A method according to claim 10, wherein said decoding nucleotide is immediately adjacent to said priming sequence.
19. A method according to claim 10, wherein said decoding probe comprises at least one nucleotide between said priming sequence and said decoding nucleotide.

20. A method according to claim 19, wherein said at least one nucleotide comprises a random distribution of each nucleotide at each position between said priming sequence and said decoding nucleotide.

21. A method according to claim 20, wherein said decoding probe comprises at least one nucleotide 5' and at least one nucleotide 3' to said decoding nucleotide.

22. A method according to claim 22 wherein said at least one nucleotide 5' and at least one nucleotide 3' to said decoding nucleotide comprises a random distribution of each nucleotide at each position between said priming sequence and said decoding nucleotide and each nucleotide 3' to said decoding nucleotide.

23. The method according to claim 10 wherein said decoding probe further comprises at least one nucleotide 3' to said decoding nucleotide.

24. A method of decoding an array composition comprising

a) providing an array composition comprising:

- i) a substrate with a surface comprising discrete sites; and
- ii) a population of microspheres comprising at least a first and a second subpopulation distributed on said discrete sites, wherein each subpopulation comprises an identifier nucleic acid sequence comprising:

1) a primer sequence; and

2) a decoding sequence adjacent to said primer sequence;

wherein said microspheres are distributed on said surface; and

b) adding to said array composition a first probe of a set of combinatorial decoding probes each probe comprising:

i) a priming sequence complementary to said primer sequence;

ii) at least one decoding nucleotide that will basepair with at least one nucleotide of at least one of said decoding sequences, said decoding nucleotide comprising a label; and

c) detecting the presence of said label.

25. The method according to claim 25, further comprising:

d) adding to said array composition a second probe of a set of combinatorial decoding probes each probe comprising:

- i) a priming sequence complementary to said primer sequence;
- ii) at least one decoding nucleotide that will basepair with at least one nucleotide of at least one of said decoding sequences, said decoding nucleotide comprising a label; and

e) detecting the presence of said label.

26. A kit comprising:

a) a substrate comprising a surface with discrete sites;

b) a population of microspheres comprising at least a first and a second subpopulation, wherein each subpopulation comprises an identifier nucleic acid sequence comprising:

- 1) a primer sequence; and
- 2) a decoding sequence adjacent to said primer sequence; and

c) a decoder probe composition comprising a plurality of probes each comprising:

- 1) a priming sequence, wherein said priming sequence is complementary to said primer sequence of said identifier nucleic acid; and
- 2) at least one decoding nucleic acid, wherein said at least one decoding nucleic acid comprises a detection nucleic acid that is complementary to a nucleotide in said identifier probe, wherein said detection nucleic acid comprises a label.